

## Distinguishing between organic substances – Level 3

(see also Level 2 summary) at [http://chemicalminds.wikispaces.com/2.5\\_Organic\\_AS91165](http://chemicalminds.wikispaces.com/2.5_Organic_AS91165)

	water	NH <sub>3</sub>	add Tollens reagent and heat	warm with Fehling's or Benedicts solution	Cu <sup>2+</sup>	conc HCl	heat with acidified MnO <sub>4</sub> <sup>-</sup>	heat with acidified Cr <sub>2</sub> O <sub>7</sub> <sup>2-</sup>	Universal indicator	DAMP litmus paper
<b>amine</b>	soluble				complex ions forms with a <b>deep blue</b> colour	white cloud forms			<b>blue</b> colour	damp <b>red</b> litmus paper turns <b>blue</b>
<b>alcohol</b> (primary)							oxidation reaction ( <b>partial</b> ) <b>purple</b> → colourless forming aldehyde oxidation reaction ( <b>total/full</b> ) <b>purple</b> → colourless forming carboxylic acid	oxidation reaction ( <b>partial</b> ) <b>orange</b> → <b>green</b> forming aldehyde oxidation reaction ( <b>total/full</b> ) <b>purple</b> → colourless forming carboxylic acid		
<b>alcohol</b> (secondary)							oxidation reaction <b>purple</b> → colourless forming ketone	oxidation reaction <b>orange</b> → <b>green</b> ketone		
<b>alcohol</b> (tertiary)							no reaction	no reaction		
<b>aldehyde</b>			colourless solution forms silver mirror or <b>black</b> precipitate	<b>blue</b> solution changes to a <b>brick red</b> precipitate			oxidation reaction <b>purple</b> → colourless forming carboxylic acid	oxidation reaction <b>purple</b> → colourless forming carboxylic acid		
<b>ketone</b>			no reaction	no reaction			no reaction	no reaction		

<b>ester</b>	insoluble & less dense, visible ester layer at top									
<b>carboxylic acid</b>									orange or yellow as acidic	damp blue litmus paper turns red
<b>amide</b>									no change	no change
<b>acyl chloride</b>	vigorous exothermic reaction, fumes given off forming carboxylic acid	white fumes given off					vigorous exothermic reaction	vigorous exothermic reaction	red colour	damp blue litmus paper turns red

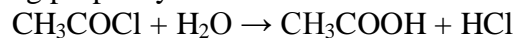
#### amine with water

eg propanamine in water



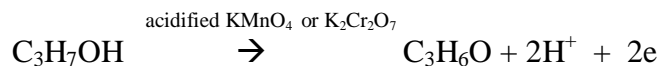
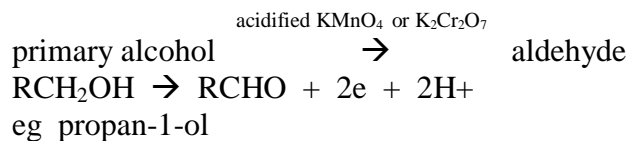
#### acyl chloride with water

eg propanoyl chloride with water



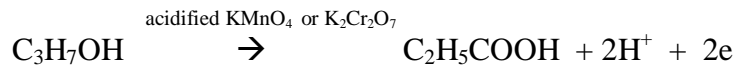
oxidation (you will not be required to write half or full redox equations in with Organic exam)

#### partial oxidation of a primary alcohol



### full/complete oxidation of a primary alcohol

primary alcohol  $\xrightarrow{\text{acidified KMnO}_4 \text{ or K}_2\text{Cr}_2\text{O}_7}$  carboxylic acid  
 $\text{RCH}_2\text{OH} \rightarrow \text{RCHO} + 2\text{e}^- + 2\text{H}^+$   
eg propan-1-ol



### oxidation of a secondary alcohol

secondary alcohol  $\xrightarrow{\text{acidified KMnO}_4 \text{ or K}_2\text{Cr}_2\text{O}_7}$  ketone  
 $\text{RCH}_2\text{OH} \rightarrow \text{RCHO} + 2\text{e}^- + 2\text{H}^+$   
eg propan-2-ol



carboxylic acids +  $\text{H}_2\text{O} \rightleftharpoons$  carboxylate ion +  $\text{H}_3\text{O}^+$  (*weak acids so only partially dissociate*)  
eg propanoic acid in water  
 $\text{C}_2\text{H}_5\text{COOH} + \text{H}_2\text{O} \rightleftharpoons$  propanoate ion +  $\text{H}_3\text{O}^+$

Tollens reagent is reduced by aldehydes to form a silver metal, known as the “silver mirror” test  
 $\text{Ag}(\text{NH}_3)_2^+ (\text{aq}) + \text{e}^- \rightarrow \text{Ag} (\text{s}) + 2\text{NH}_3 (\text{aq})$

the aldehyde is oxidised to form a carboxylic acid (  
 $\text{RCHO}(\text{aq}) + 2\text{OH}^-(\text{aq}) \rightarrow \text{RCOOH}(\text{aq}) + \text{H}_2\text{O}(\text{l}) + 2\text{e}^-$

eg propanal in Tollen's  
 $\text{CH}_3\text{CH}_2\text{CHO} + \text{Ag}^+ \rightarrow \text{CH}_3\text{COOH} + \text{Ag}$   
(OR half equations)

### Fehlings and Benedicts Solutions

the blue aqueous copper ions are reduced by aldehydes to form a red insoluble solid  
 $2\text{Cu}^{2+} (\text{aq}) + 2\text{OH}^-(\text{aq}) + 2\text{e}^- \rightarrow \text{Cu}_2\text{O}(\text{s}) + \text{H}_2\text{O}(\text{l})$